

"Doing what comes naturally" in mathematics education? The role of social class in pre-service teachers' responses to innovative mathematics pedagogies

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This paper reports on a small scale study in mathematics subject knowledge teaching in a secondary mathematics pre-service teacher education course in the United Kingdom (UK). "Responsible" and "ambitious" pedagogies are adopted on the course. Accounts taken from a larger study are offered from four participants reflecting on their experiences of the course. Permeating the narrative accounts is a sense of the interviewees' *dispositions* towards learning (and teaching) mathematics and the potentially classed nature of these. Drawing on Bourdieu's concepts of *habitus*, *field* and *capital*, we argue that these dispositions are related to issues of power with which we need, as researchers and as teacher educators, to engage.

Keywords pre-service teachers, mathematical subject knowledge, social class, Bourdieu

Introduction

In this study we report on a pre-service teacher education course which has a year long mathematics subject knowledge component. "Responsible" and "ambitious" pedagogies are adopted on the course. We take "responsible" pedagogies to be those in which teachers strive to be responsive to and respectful of learners (Rust, 2006) and where learners are encouraged to develop a sense of responsibility and a commitment to justice, equality and democracy (Fillion, 2007). The importance of the learning community both in and of itself and also as supportive of the development of relational equity (Boaler, 2008) is stressed. "Ambitious" pedagogies we take to mean those in which we have ambitious learning goals for all students, with high expectations and a commitment to attainment for all (Lampert, M. et al., 2010; Povey, 2014).

As a result of reflections on practice in general and on an in-depth study of the experiences of a small number of students in particular, we have come to question whether such pre-service teacher education practices take sufficient account of how the students' responses to those pedagogies are classed, "raced", related to age and gendered. Relatively little research has been conducted on this situatedness: the purpose of this exploratory paper is to offer evidence in support of such questioning with respect to social class.



Using a narrative approach, accounts taken from a larger study are offered from four participants reflecting on their experiences of the course. Permeating the narrative accounts is a sense of the interviewees' *dispositions* towards learning mathematics and the potentially classed nature of these. We discuss Bourdieu's concepts of *habitus*, *field* and *capital*, and use these to interrogate our data, arguing that the innovative pedagogies employed are differentially available in "non-random" (Jorgesen, Gates, & Roper, 2013, p. 8) ways to these students. We compare their learning experiences with those of Lubienski's school students (2000, 2002) and claim that these differentials are related to issues of power: we argue that these issues are ones with which, through critical reflexivity, researchers and teacher educators need to engage.

Mathematics subject knowledge

It used to be assumed that, for entrants to teaching, mathematical subject knowledge itself was unproblematic and that pre-service teacher education was simply about how to teach that content: "teacher educators tend to take prospective teachers' subject knowledge for granted, focusing on pedagogical knowledge and skills" (Ball, 1988, p. 8). However in the last two decades a significant body of research has been conducted which relates to mathematics teachers' subject knowledge and its relationship to effective mathematics teaching, showing that the previous assumptions cannot automatically be taken for granted: "it is axiomatic that teachers' knowledge of mathematics alone is insufficient to support their attempts to teach for understanding" (Silverman & Thompson, 2008, p. 499).

Institutions vary widely in how the initial teacher education experience is organised. In particular there are differences in the way that mathematics subject knowledge and knowledge about how to teach mathematics are interrelated or otherwise. Gess-Newsome (1999), developing the ideas of Ball (1988) and Shulman (1986), proposes two models for working on subject knowledge in pre-service teacher education: he terms these, somewhat confusingly, the *integrative* model on the one hand and the *transformative* model on the other. In the integrative model, the two strands are kept completely separate. Student teachers have independent knowledge bases of mathematics subject matter and mathematics pedagogy; they then need to integrate these to create effective learning opportunities - the integration is done by the students themselves rather than through their experience of an integrated approach within their pre-service teacher education. This represents the current experience for many students on pre-service teacher education courses and they struggle to put together such compartmentalised knowledge in order to be effective teachers of mathematics. As Gess-Newsome posits, there are major problems with the integrative model with many students failing to overcome the given compartmentalisation. In contrast to this, the transformative model offers experiences which are themselves purposefully integrated, connecting mathematical and pedagogical understandings - the integration is done at the level of course design and delivery rather than by the individual students post hoc. In this study we report on a course the philosophy of which is firmly wedded to the transformative approach.

One of the key issues in the education of mathematics teachers is what has been termed the "baggage" they bring with them to their pre-service teacher education. Everyone who is going to teach mathematics has been a pupil in schools for many years and as a consequence "prospective teachers enter teacher education programs already feeling quite at ease with their knowledge of what teaching and learning look like" (Nolan, 2012, p. 202). For many, developing a practice that teaches for understanding through "responsible" and "ambitious" pedagogies may be extremely difficult as many will never have experienced such pedagogies themselves as learners. Teaching mathematics will be about learning rules, tricks and definitions and there

will be limited capacity to transform and connect knowledge and to respond flexibly and appropriately to classroom contingencies. These difficulties are well established (Ball, 1988, 1989; Cooney & Wiegel, 2003; Nolan, 2012). However, what has been less the focus of attention is the extent to which the so-called "baggage" is classed, "raced", related to age and gendered, with comparatively little research conducted on such situatedness. In this paper, we draw on a small scale exploratory study from which class issues emerged in students' response to inquiry-based, student-focused pedagogy.

Context of and background to the study

The context for this study is a two year route into teaching where the first year is concerned with mathematics subject knowledge enhancement and the second is concerned with professional studies and professional practice. Within the subject knowledge enhancement aspect of the course, there has been a long-standing commitment to "responsible" and "ambitious" pedagogies (see, for example, Alro and Skovsmose, 2002; Brown & Walter, 1993; Gutstein, 2006; Mason, Burton, & Stacey, 1982; Ollerton & Watson, 2001; Nardi & Steward, 2003; Noyes, 2009; Schoenfeld, 1988; Staples, 2008). In our work, we invoke the metaphor of *spaciousness*, with spacious classroom relationships connected to an understanding of mathematics as a spacious discipline (Angier & Povey, 1999). In previous research seeking better to understand our own practices (Povey & Angier, 2004), we have constructed the following themes about how our students understand our pedagogy: mathematics is negotiable, a subject to explore; assessment in mathematics can be personal; learning is social, supported and collaborative. These clearly echo our beliefs and values. We emphasise reflection and give our students space to grapple with mathematical tasks. We seldom give full solutions or come to tidy ends; instead we leave the students to develop the authority to decide when something is finished or solved. We encourage, and even insist, on group collaboration where responsibility for progress is shared because we believe that mathematics is rarely recognised as a social endeavour. We acknowledge complexity, difference and difficulty throughout the history of mathematical ideas (Povey & Angier, 2006, p. 469). We stress the importance of the learning community both in and of itself and also as supportive of the development of relational equity (Boaler, 2008).

The data reported here are drawn from one cohort of twenty which formed part of a larger study. Full ethical approval was obtained for the study through standard university ethics procedures. Several of the students also participated in a mathematics enrichment project which involved running several workshops for students in the second year of secondary school. The students were each interviewed in small groups and the first named author then transcribed the data, initially longhand into notebooks, and subsequently onto the computer. These data were initially analysed by the first named author using a narrative methodology with a focus simply on the acquisition of mathematics subject knowledge (Jackson, 2011) *per se*. However, aspects of the data continued to "trouble" him: permeating the accounts was a sense of the interviewees' *dispositions* towards mathematics and the classed nature of these. He invited the second named author to work with him to re-analyse the accounts, considering the social location of the individual participants and interrogating their narratives using a Bourdieurian perspective. Here we present four of these accounts as cases. Drawing on Bourdieu's concepts of *habitus*, *field* and *capital* (1990), we argue that these *dispositions* are related to issues of power with which we need, as researchers and as teacher educators, to engage.

Theoretical background: working with Bourdieu

In recent years, mathematics education researchers who are interested in social justice issues (for, example, Gates & Noyes, 2014; Jorgensen, Gates, & Roper, 2013; Nolan, 2012; Noyes, 2004) have begun to draw on the ideas of Pierre Bourdieu to help them analyse and understand the phenomena that they are investigating, to help make sense of the relationship between objective social structures and what people do and why (Webb, Schirato, & Danaher, 2002, p. 1). Bourdieu develops his theory as a means to an end - a way to act on the world and change it (Webb, Schirato, & Danaher, 2002, p. 8) - and that is the intention of the current paper.

For Bourdieu a central concept is that of *habitus*: a system of "structured, structuring dispositions" (1990, p. 52) shared by a social grouping. The social groupings with which we are concerned in this paper relate to social class as understood, specifically, in contemporary United Kingdom (UK) society. Social class is based on the interactions between social, cultural and economic background and status, with the social and cultural foregrounded in the construction of social class identity. Traditional definitions of class relied heavily on occupation and occupational status (Office for National Statistics) but the subjective sense of class location, rather than simply economic placement, gives a reliable and sometimes predictive indicator of *habitus*. Class has a powerful influence on people's personality and behaviour and predicts

what clothes people wear; what food they eat; how they talk; their attitudes, values and preferences; and their physical and mental health. (Rubin et al, 2014, p. 196)

How this plays out in practice will vary from cultural location to cultural location but where, as in the UK, class is a key sociocultural variable, it will be easily recognised both in oneself and in others. In the UK, a working class location is associated with strictly limited *cultural capital* in contrast to a middle class location. We say more about this below.

The *habitus* is both a structured structure within which a person experiences the world and also a structuring structure with which a person generatively interacts with and contributes to the construction of that world through practice. It is historical, sedimented and durable and produced by the particular conditions of existence. It is constituted by

systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles which generate and organise practices and representations that can be objectively adapted to their outcomes without presupposing a conscious aiming at ends ... without being in anyway the product of obedience to rules, they can be collectively orchestrated without being the product of the organising action of the conductor. (Bourdieu, 1990, p. 53)

Thus it grows out of the originating social milieu - but the dispositions so created also restructure the social space. However, this restructuring is patterned in such a way that the dispositions are pre-adapted to the demands of the social space and therefore, whilst allowing for improvisation, largely reproduce the given relationships, expectations, practices and social outcomes: "the habitus makes possible the free production of all the thoughts, perceptions and actions inherent in the particular conditions of its production - and only those" (Bourdieu, 1990, p. 55). There is an infinite set of responses that can be made within a given *habitus* in a given social situation - in this sense, the *habitus* is not deterministic or mechanical - but those responses are strictly framed.

Such generative structures must be understood as fluid, or dynamic, constantly changing and developing, but durable and stable in establishing dispositional knowledge: a tendency with limits towards certain responses when faced with external stimuli. (Grenfell, 2004, p. 27)

So what we consider to be "doing what comes naturally" is a product of the internalised, embodied history, the "materialisation of the collective memory" (Bourdieu, 1990, p. 291) that is the *habitus*. Thus it generates "reasonable" and "common sense" behaviours (Bourdieu, 1990, p. 55), "sensible" responses to events, with new experiences structured by the structures of the past. The *habitus* works to ensure that we behave "correctly" with more reliability than would be achieved by "all formal rules and explicit norms" (Harker & May, 1993, p. 174), orientating rather than strictly determining action.

Bourdieu locates the development of the *habitus* within a *field*. He draws on the idea of a field of play in a game and contrasts this with a social field of play. Social fields are not entered into consciously and by choice: they are that into which we are born. In the case of games which are played in the social field, "one is born into the game" (Bourdieu, 1990, p. 67). Like a game, a social field is shaped by taken for granted rules and regulatory practices that go unchallenged and become unquestioned and unquestionable by the social players immersed in the game. In this way, the status quo, and with it the current "winners" and "losers", is reproduced.

A given *habitus* and *field* share generative principles and exist in dialectical relationship with one another, producing and reproducing each other: "Social reality exists, so to speak, twice, in things and in minds, in fields and in habitus, outside and inside of agents" (Webb, Schirato, & Danaher, 2002, p. 18). The physical and social spaces which they create are where "power is asserted and exercised" (Bourdieu et al., 1999, p. 126) and where domination is enabled. The two fit together and, since there is this fit, what can be done, thought or not thought within the *field* is limited and defined in terms of what is legitimate and legitimated (by those with symbolic power) within that field. This way of thinking and acting is the orthodoxy for that *field* - the *doxa* (Grenfell, 2004, p. 28). Anything else is unorthodox, although what is *doxic* in one field may be *heterodoxic* in another.

Bourdieu urges us to see how these concepts of *habitus* and *field* can be put to work to help us to make sense of the world (Webb, Schirato and Danaher, 2002, p. 81). In mobilising the concept of field, he makes three interconnected moves.

He analyses the relation of the field under question to the field of power; he maps out the positions available within the field, and especially those positions that are the subject of competition for field-specific capital; and, finally, he analyses the habitus of the individuals who occupy the field to determine how their dispositions have come into being and have been internalised, and what sort of tendencies they generate. (Webb, Schirato and Danaher, 2002, p. 82)

In order to understand the power that any individual has in a social field Bourdieu invokes the idea of *capital*. Capital can take many forms, both material and symbolic; here we are concerned with *cultural capital*, those (arbitrary) cultural resources that provide "the feel for the game" that we noted earlier through, for example, education (1999, p. 424), body mannerisms and ways of talking (1999, p. 128). As such, it plays a crucial role in the reproduction of dominant (and unjust) social relations and structures (Webb, Schirato, & Danaher, 2002, p. 110) - and thus provides a vital tool in understanding how inequalities are reproduced - by legitimating differences in social power and importance. Typically, such differentiation will not be recognised as being based on the outcome of (cultural) capital accumulation; rather it will be seen as resulting from "someone's natural or inherent quality" (Webb, Schirato, & Danaher, 2002, p. 152).

In the discussion which follows, these three inter-related and mutually constitutive concepts - *habitus*, *field* and *capital* - are used to try to make sense of pre-service students' responses to an innovative, problem-solving pedagogy in their university mathematics classrooms.

The narrative accounts

In the context of research related to equity issues, narrative methodology can play a significant role because of what Clough has termed the "unavoidable moral urgency" (2002, p. 99) of stories. Bruner (1987) argues that storying is a fundamental way to make sense of the world - that it is characteristically human to think in stories - and that stories imply intentional states. In constructing narratives, however, we acknowledge that it is the researcher's categories, concepts, constructs and so on which frame and shape the work and it is, in this sense, the researcher's story which is told. The first author sought out the participants' personal involvement, openness, exposure and trust but there was not full reciprocity. As a result of the imbalance in vulnerability, there is no answer to the question "what right have you to characterise me in this way, or that?" (Povey & Angier, 2013).

So how then do we decide upon the worthwhileness of a narrative? Some have suggested that the extent to which the story "speaks to us" is what is crucially important: the "locus of responsibility for generalizations" (MacDonald, 1977, p. 54) is intended to be with the reader. Mulholland and Wallace (2003) suggest *strength* criteria, *sharing* criteria and *service* criteria. The strength criteria focus on how the research is conducted; the sharing criteria focus on how the reader is able to experience the world of the participant; and the service criteria focus on what is to be done. We should like our narratives to be judged against each of these.

Here, then, we offer the accounts of four case-study students - Brian, Clara, Tom and Debbie - not making any claim to representativeness but rather offering each as a "serious example" (Skovsmose, 1994, p. 9). (All names are pseudonyms.) We seek to tease out and illustrate their relationships with and to mathematical learning and mathematical subject knowledge, bringing this "'up close' as opposed to 'out there' distant and abstract" (Gudmundsdottir, 1997, p. 1). We wanted to achieve this "up close"-ness for ourselves, our colleagues and other readers of this research. In experiencing "up close" the perspectives and interpretations of our students, we have a significant catalyst for changing our practice. Being close enough to each other in research, though risky, keeps the moral dimension to the fore (Bauman, 1989). In this way we hope to enrich the understanding of the "complex world" (Doyle, 1997, p. 96) of pre-service teacher education mathematics classrooms. Following Bourdieu and his co-authors (1999) we have striven to make these accounts ones which keep faithful to the participants' *raison d'être*, to help situate the reader in the place in which the participants' worldview "becomes self-evident, necessary, *taken for granted*" (p. 625, original italics).

Brian

Brian was a working class man in his early forties. (We use these social class terms intuitively based on our observations of their speech patterns, dress, humour and so on and our informal conversations with them over the course of the research.) He had spent many years working as an engineer before he started the pre-service teacher education course. He decided to apply for the course because he was concerned about the future of engineering in the region and hence about his future employment prospects. At the beginning of the year Brian's mathematical subject knowledge was insecure; he lacked confidence and needed a lot of reassurance about his mathematics.

Before he started the first year of the course he had conceived ideas about it that were fundamentally wrong and seemed to reflect back on his own schooldays. Despite clear statements to the contrary in the course publicity and at the course interview, when talking about the lecturers he said "I thought they were going to go through ... differentiation and the

best ways of teaching it". Despite the very clear and public focus of the course as being about studying undergraduate mathematics, he thought "that we'd spend a lot more time in schools. I was shocked when I found out it wasn't that really". He thought there would be "more about classroom behaviour and how to deal with unruly students in certain situations".

One of the key features of the year is there is a strong emphasis on learning in groups; this is very much a new experience for the vast majority of the students. Brian appeared to find it problematic to be working in a group with people who he felt were very unlike him.

they set up little cliques. I think that's what happened; there were little cliques within groups ... if they could do it, they'd do it well and do it quickly and then start discussing other things.

He expressed concern that one of the other working class men had been in a group in which he had "nothing in common" with the other people. Brian thought that, if the groups had been mixed up differently, then this colleague might have worked with him and the rest of the group of working class men.

He had a fairly instrumental way of understanding the benefits of group work.

When you were doing some problem solving in class, you did get a lot out of it, from the other people as well 'cos obviously if they'd come across it and they'd been doing it recently they went, "ah yeah, you apply this to it" and you will learn off of them and you say, which way, how do you do that?

To support their mathematical studies these working class men had set up a "revision" group outside of classes. Brian described it as having gone "back to basics", drawing on a discourse of mathematics teaching and learning associated with a narrow curriculum and rote learning.

These understandings were not monolithic however. Brian had been involved in the mathematics enrichment project for pupils which had given him a different perspective on mathematics teaching and children's relationship to it. Brian thought that "if you make something creative and get [the pupils] involved you know how much they get out of it as well as you". Brian's involvement with the mathematics project seemed to have shown him the value of creativity in mathematics in a way he had not taken on board through his experiences on the course of working on his own mathematics.

Despite the first year being very different from his preconceptions, it was, in his own words,

a lot different from what I expected, more maths orientated ... I really enjoyed the course. I thought ... it made you think deeply about situations, it made you read articles you wouldn't read. I think you're a better person for it 'cos it stretches you in different areas, sometimes painful but it's rewarding.

He thought that what the course was really about was "discovering yourself, discovering that knowledge working with other people". He said it had been quite painful at times, that sometimes "you were out of your comfort zone - I found every unit challenging to one degree or another". Nevertheless, his views and practice with respect to mathematics teaching remained largely unchanged.

Clara

Clara was an articulate middle class woman in her early twenties and had started a couple of degrees before but for a variety of reasons had not completed more than the first year. She had started a mathematics degree, then she had done a year on a civil engineering degree but had moved because of "some personal stuff". Eventually she had decided to become a mathematics teacher. Clara said



The first day I came in and it's all set up like a classroom and ... it felt, it was different to any of the teaching on the courses I've done. ... The course here is extremely interactive, which is a really great thing, and you have really great fun doing that so that it was different.

Clara had a more complex understanding of the reasons behind many of the activities on the course. An early example was poster making which was part of an early assignment. She said

We weren't being marked purely on the poster making skills. It was about understanding a mathematical problem enough to be able to present it in a certain way, to be able to get it across, it was about all the other stuff, yeah, the whole course is about whatever the front, yeah, we've done some paper folding today, yeah, it's not about that, ... it's about experiencing learning maths and it's about how its taught, how you look at maths and how you put the maths across.

Clara felt that in the second semester

You get more of an idea about why you're here and what we are trying to achieve rather than ... the first bit you're sort of a bit odd and there's all this stuff going on and I'm trying to absorb as much of it as possible but its hard work. But by the second semester you're more prepared to go into the lesson and have to think about something that seems completely random.

She had found working in a group supportive and quite a positive thing. She had not been "really, really challenged" by the course but there was "always something challenging to work on and it's never been easy". She explicitly connected her experience of learning mathematics on the course with her expectations for teaching in the following year. The mathematics project had provided an opportunity to get a bit of experience: she thought the pupils would go away having had a good time and having learned something. Mathematics was not all about getting ticks which was how they had all been brought up; and in some ways the mathematics events for the pupils were like the first year of her two year course. They were all expecting ticks but instead had to struggle to understand what was happening without continual feedback. However, Clara resisted the idea that these experiences should carry over into the school mathematics classroom. She said it was "not anything like teaching will be. It is the fun positive side of it".

Tom

Tom was an ex-serviceman in his forties with a family and was originally from the working class. During his time in the services he improved his educational qualifications. When he left the services he went to university and obtained a degree. He had a number of middle class jobs since leaving before eventually deciding he wanted to become a mathematics teacher.

Tom's expectations about the first year of the course before he arrived at the university were radically different from what actually happened during the first year. He said

[my] expectation(s) from my interview was that the first year was going to be a booster ... I thought there would be a lot more going back through [school leaving] work and that sort of thing.

Again, he was neither told that at interview nor in the information sent to him. As well as expecting to be taught school leaving level mathematics he was expecting something completely different in terms of teaching and learning. He said, "I was expecting to be taught board-work, textbook, writing things down, making notes, doing exercises". However he was very positive about his experiences: "the maths I got out of it was probably more than if we'd been doing board-work ... I found it really stimulating".

Working in groups was sometimes an issue for Tom. In common with the other working class men he did not understand the rationale for the groupings and in his experience the dynamics of the classroom meant that "you couldn't find your natural learning partners". Tom felt that "on reflection ... there's a lot of implicit goings on throughout the course" and, in marked contrast to some others, he said he had learned a lot about how to behave in the mathematics classroom by observing the tutors and lecturers. Towards the end of the course Tom said that when he had started

I was under the impression I was going to come here and be spoon-fed calculus and differentiation and integration and that sort of thing ... [but I soon realised] I was responsible for my own learning and nobody was going to take responsibility for that unless I took it myself and then I could start to make some headway.

He had found the experience extremely challenging mathematically. He had really struggled in the first few weeks. He kept asking himself "What am I supposed to be doing?" But as the course progressed, Tom made important steps in his understanding about what it is to learn and to do mathematics. He said

As soon as I got my head around not being spoon-fed and I realised I was free to do this or explore that or go off in that direction or think, oh now I need some more help on this one and go down that route I was okay. I enjoyed the challenge really.

Involvement with the mathematics project had given Tom a lot of ideas about creativity in mathematics lessons. Tom expressed the view that

I want to go into a job where I know there's people on the outside in the universities, and doing all this research, doing all these maths [project] event days, that sort of thing, to make maths more creative, more interesting and it's not just sitting in a class and left to a teacher. You know that there's this wider community interested in mathematics learning at that level.

Tom had significantly changed his approach to the subject through his own engagement with more open and creative mathematical tasks

Debbie

Debbie was an articulate, slightly unconventional, young woman of middle class origins in her mid-twenties. She had completed a psychology degree previously and had been working as a careers advisor at a local college. Quite out of the blue she had thought about teaching mathematics. She had done some research on the internet and then in the space of two weeks applied for the course, been interviewed and accepted, quitting her job in the process. She said, "I applied late [so] I didn't really have time to think about it".

She compared the course with her previous degree, saying, "It [is] smaller and more intensive here. I didn't expect to be in from nine to four every day". Debbie said she had really enjoyed the course but reported that when describing it to her friends she had a tendency to describe the course in quite trivial terms: "All I ever tell my friends is, I've been colouring today, I've been making shapes". When challenged about this she said that it was not her intention to put the course down; she had really enjoyed it. She contrasted her experience on the course with her expectations. She said she expected that the year of mathematical study "was just a year I had to get through" because she had a friend who had done a mathematics degree which he had just hated and she thought her experience would be the same.

The thing she found most unnerving about the course was that there had been no early written feedback.

I had no idea [talking about mathematics assignments] what the standard was ... I could write essays ... and I could tell that essay is going to pass, but I had no idea with some of my projects. They could have failed and I wouldn't have been majorly surprised.

The assessment for the course is not graduated so all Debbie was required to do was obtain a pass in each module. Despite this she said

It's been a good thing on the course that I've been interested enough that I wanted to make my project better ... I'm still quite annoyed about that project, there was loads more I could have done and it was really interesting, I'd have liked another week please.

There was a culture of continuous work and tutors cared about whether you were getting on with your work. She liked the fact that she had to be in from nine to four, four days a week. On her previous degree she had gone to the first lecture on one module, decided it was not going to be that interesting and not gone to any more. She said that was accepted practice and she'd still managed to pass with a good mark. She said it "did me no harm whatsoever but it would do you a lot of harm if you didn't turn up for the lectures here".

She liked watching different people learn and she liked the range of people on the course because of that. She found it interesting to see how some people could get frustrated with the way they were being taught.

Debbie had found the course quite challenging at the beginning as she had not done any mathematics for five years. Like many others on the course she had thought that there would be a bit of a refresher but "No, none of that! Just throw you straight in and hope for the best which was fine but it was a bit disorientating at first. I really liked it in the end".

Debbie said it was a complete luxury to have spent a year learning mathematics but she felt the contrast with what was expected of her in school.

Nobody wants to play. They don't like all my exciting ideas, they just want me to write things on the board that they can copy down ... I know it's a long slow process and you just have to. At least we've got the idea that we don't just want to write things on the board and have people copy it down.

She believed that "teaching interactively" was "doing the right thing". Her involvement with the mathematics project made her want to lobby for more mathematics trips because "mathematics never gets any because nobody expects mathematics to be fun, nobody expects mathematics to be the subject where you go on trips"; and she did not see much difference between running such a workshop and teaching.

Discussion

We regard these students as "typical" though, of course, not representative in any formal sense. We suggest these narrative responses to our "responsible" and "ambitious" pedagogy in the pre-service mathematics subject knowledge classroom show that our practices were differentially available in "non-random" (Jorgesen, Gates, & Roper, 2013, p. 8) ways to these students. Debbie and Clara were middle class students, both in social background and in current cultural markers - clothes, accent, behaviour, and so on. Tom and Brian were both of working class origin. Brian continued to present himself as working class in manner and taste, aligning himself strongly with the other working class students and claiming "people like him" had "nothing in common" with others not so identified. Tom entered the class with a *habitus* that seemed to have much in common with Brian's and initially was far from that "undisputed, pre-reflexive, naïve, native compliance" (Bourdieu, 1990, p. 68) with the basic assumptions of the *field* and its *doxa*: he kept asking himself "what am I supposed to be doing?" (The reader will



note that our two middle class cases are younger women and our two working class participants are older men. We do not rule out the possibility that either or both of these lenses - age and gender - might also prove fruitful in making sense of the social world we are investigating. Indeed, we anticipate revisiting our data through a gender lens. However, we consider that our reading of the narratives through the lens of social class is rich enough to be worth standing on its own.)

Both Debbie and Clara had had expectations that the course would conform to common practices in the *field* of higher education mathematics (Macrae et al., 2003; Mann, 2003; Solomon, Croft, & Lawson, 2010): they expected to be *educated* (albeit in a rather dull and uninspiring ways), to be able to understand what was expected and to perform adequately accordingly. When these expectations were not met, however, their *habitus* allowed relatively easy adaptation to a different set of higher education expectations. As we read Debbie's account, we can hear how she was able successfully to align herself with the *field* of our mathematics classrooms. Initial worries about whether she could pass the course were soon set aside as she found her *cultural capital* - independent problem-solving, creativity and originality - carried value in the field. So good was the fit between her *habitus* and the *field* that she was able to take liberties with the rules that define excellence (Bourdieu, 1990, p. 298): she expressed "annoyance" with assessment deadlines that interrupted the flow of her work and was able to mock the work - "I've been colouring today" - at which she was excelling. Similarly, Clara, confronted with the initially unexpected, was able quickly to learn the "rules of the game" and confidently give back to her tutors the *doxa* of the *field*: mathematics learning is "interactive", can be "great fun" and is all about "understanding a mathematical problem".

The expectations of Brian and Tom were very different from Debbie and Clara. Despite many explicit messages to the contrary, they were anticipating a narrow mathematics experience, *apprenticing* them to the role of secondary mathematics teacher. Tom had expected "a lot more going back through [school level] work ... [being] spoon-fed calculus and differentiation and integration" and Brian was "shocked" that this didn't happen. In addition, he had a strong expectation, again despite clear information to the contrary, that the mathematics subject knowledge year would be focused significantly on *teacher craft*. These two perspectives, one of education and the other of training, were allied to the pre-existing class-based *habitus* of the pre-service students; one made entry into the *field* of problem-solving pedagogies with its rules of "no rules" much smoother, more congenial and altogether easier than the other. Brian's response was, at least in part, to decline entry to the offered game and to assert and legitimate an alternative *field* compatible with his *habitus* (Webb, Schirato, & Danaher, 2002, p. 111). He set up a "back to basics" group for himself and the other working class students, where the rules of the game were different from our mathematics classroom, creating a *field* which recognised and gave value to playing to the rules as he knew them.

Another marked difference amongst the participants was their response to group work. Much of the time on our course, students are required to work together in pre-determined groups not of their own choosing. Our intention is to promote engagement with and understanding of the topics covered and we adopt "a relational approach ... emphasising sensitivity, trust, inclusion and mutual respect between group members" (Baines, Rubie-Davies, & Blatchford, 2009, p. 97). For Clara participating in the group work had been unproblematic. Debbie had thoroughly enjoyed working with a variety of people including those unlike herself and had "liked watching different people learn". This suggests there was an excellent fit between her *habitus* and the new *field* she was entering: "the closer the fit between field and habitus, the more likely is someone to feel like a 'fish in water', and vice versa" (Grenfell, 2004, p. 29) The initial fit was poor for both Brian and Tom who found the group work difficult to manage. Tom reported that the structured groups meant "you couldn't find your natural

learning partners" and Brian felt himself excluded by "little cliques". Brian's strategy of the "back to basics" group mentioned above showed the improvisation available to players in social games: he regularised his situation and, in part, beat us at our own game (Harker & May, 1993, p. 176) by initiating collaboration between learners in a contrasting *field*. But it appeared to us to keep his engagement with mathematics instrumental and to equip him less well for teaching.

Tom stands in contrast to Brian. He appears to us to be someone who made "the slow process of co-option and initiation which is equivalent to a second birth" (Bourdieu, 1990, p. 68) into the *field* of "responsible" and "ambitious" pedagogies. He had "learned a lot about how to behave" in the *field* by observing its experienced players, his tutors and lecturers, and had moved from seeing himself only as a craft-based apprentice to someone who was part of a wider mathematics education community that embraced intellectual work and creativity. Unlike Brian, he wanted and expected to make links between the course and their subsequent teaching. A similar contrast is apparent with Debbie and Clara. Though Clara's *habitus* could adapt comfortably to the *field* in which she found herself in the subject knowledge classroom at the university, like Noyes' students (2007) this left unchallenged the "naturalness" of "ordinary school mathematics" - the "fun" was not part of the rules of that game. Debbie, however, knew that "nobody wants to play" but was determined to take her creative ideas into the school mathematics classroom.

Conclusion

We have argued that access to "responsible" and "ambitious" pedagogies is differentiated and that these differentials are in part a consequence of classed social heritage (Jorgesen, Gates, & Roper, 2013, p. 8). As with Lubienski's findings (2000) about her school students, the pedagogy we espouse and the culture of our classrooms seem to have aligned in fundamental ways more smoothly with our middle-class students' "preferred ways of communicating, learning and knowing" (p. 398) than with those of our working class students. Lubienski (2002) highlights two key aspects that were differentially experienced by students from different socio-economic backgrounds: discussion-based activities and problem-based inquiry. She writes

Researchers and educators should not assume that learning mathematics through problem solving and discussion is equally natural for all students. Instead, we need to uncover the cultural assumptions of these particular discourses. (p. 120)

The accounts above give testament to similar responses from our students. First, the students were required to be active participants, and not just passive recipients, in making the mathematics. Many of the tasks they were set involved open-ended problems for which no given method of solution was provided which contrasted strongly with their previous mathematical experiences. For all the students, there was some unresolved tension noticeable between the "respectable" mathematics they expected to experience and the less conventional aspects of the course. But, for Debbie and Clara and later for Tom, the gap was a source of pleasure. Brian had to work harder to accommodate the disjuncture and it was not clear that he ever did. Second, we also heard differences in the way the students responded to working with other students in discussion-based ways. Brian talked about the desire to be with "people like us" and he recognised that he struggled to "play the same game" as others who were unlike him. Tom spoke of "natural partners". These suggest that a discussion based pedagogy that failed to recognise and take into account the *habitus* of students was problematic for these two working class men. Debbie, in contrast, had welcomed the opportunity to work with others

who were different from her so that she could learn how other people thought and Clara experienced no difficulty in heterogeneous group working.

Our findings are not presented as anything other than speculative. But they challenge us to re-think our practices, to open up our process-based mathematics curriculum more effectively for all. As Gates and Noyes (2014) have noted, "*Class*, in some guise or another, is always a latent variable whose invisibility obscures possibilities for action" (p46, original emphasis). We believe that we had failed to give due notice to this dimension in the responses of our students to our mathematics teaching; and that using a Bourdieurian perspective better to understand the pre-service mathematics classroom is helpful and potentially empowering.

Jorgensen, Gates and Roper (2013) suggest that we need to encourage new teachers to "examine the nature of social conditions in schools and theorise the lack of fit between *some but not all* pupils and the demands of mathematics education" (p. 17, original emphasis). Equally, we need to enable them to understand the sources of that differential access

... when certain elements of cultural capital are prerequisites for success in mathematics classrooms, and when educators make faulty assumptions that these prerequisites come "naturally" to "all students", inequities could be exacerbated in reformed classrooms. (Lubienski, 2000, p. 399)

One way of generating such understanding must be to make explicit the power differentials in our own pre-service classrooms "revealing the workings of power associated with the privileged players (both teachers and students)" (Nolan, 2012, p. 211), drawing attention to our own complicity and seeking to understand how we reproduce patterns of inequality. Noyes (2004) has called for the development of a critical form of pre-service mathematics teacher education which involves both students and tutors in "critiquing their individual and collective contribution to the structuring of educational inequity" (p. 254).

Nolan (2012) draws attention to the fact that lack of fit between *field* and *habitus* can be experienced as a crisis for beginning teachers (p. 212). However, such a crisis can provide an opening within which to work by offering an opportunity for critical reflexivity. Critical reflexivity can make the space for us to "step back and gain distance from dispositions" (Bourdieu & Wacquant, 1992, p.136, quoted in Nolan, 2012 p. 212) including, not least, our own. *Habitus* is not destiny: it does not determine our responses to the social worlds within which we find ourselves and within which we strive to make sense. Despite (unjust) patterns in how we behave and in what we can and cannot think, it is not possible simply to "read off" from the durable and sedimented histories of the pre-service teachers what their responses will be. There is space for improvisation which can be strengthened by an understanding that "we are the ones who endow the situation with part of the potency it has over us" (Bourdieu & Wacquant, 1992, p.136, quoted in Nolan, 2012 p. 212).

We saw that Brian, Debbie, Tom and Clara are not automata. Each worked out a different response to the *field* of innovative pedagogies in pre-service mathematics subject knowledge teaching, based on their in-coming *habitus* but not wholly defined by it. Our task as teacher educators and researchers is to become much more aware of the class based understandings, dispositions and ways of being of our pre-service teachers and, in addition, to recognise the structuring power of our own *habitus* and to open it up to shared analysis and critical reflexivity.

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